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# Irrigation Management of Sugar Beets

The sugar beet is a biennial plant that is grown extensively under irrigation for sugar production. The primary source of income from sugar beet production is from the sale of the beet root which has an average sugar content of 15 to 16 per cent but may be as high as 18 per cent. A standard tonne of sugar beets is the amount of beets needed to yield 125 kg (275 lb) of sugar.

The tolerance of sugar beets to soil salinity varies depending on the stage of growth. At the germination and seedling stage, sugar beets are quite sensitive to soil salinity levels greater than 3 dS/m (yield reduction will occur at levels greater than this). However, once the crop becomes well established, its tolerance to soil salinity is quite high. (Yield reduction will occur at values greater than 7 dS/m). Sugar making quality is lowered when sugar beets are grown on saline soils.

Optimum soil temperature for germination is 25°C where the optimum air temperature for growing conditions is 17 to 24°C.

## Crop Water Requirements and Crop Yields

Sugar beets develop an active rooting zone of approximately 1.0 m (3.3 ft). The seeding date for this crop is generally between April 27 and May 7, with harvesting occuring in late September or early October. Seasonal crop moisture use over the growing season is approximately 560 mm (22 in.). Over the peak 30-day growing period, maximum water use will approach 6.0 mm/day (0.24 in.). During the seedling stage, water use will vary from 1.0 to 2.5 mm/day, using a maximum of 7.0 m/day (0.28 in.) as the crop achieves full ground cover. When 100 per cent ground cover is achieved, roots will have been developed to a depth of 1.0 m.

The critical water requirement period for sugar beets begins two to three weeks after seeding and continues until two weeks prior to harvest. It is essential to maintain good soil moisture conditions (above 50 per cent available moisture) throughout this time period. Limiting moisture at this time alters the beet plant by reducing the size and length of leaf stems. Aging and loss of older leaves is accelerated but initiation of new leaves is not seriously affected. Moisture stress reduces the growth rate of the storage root. Inducing wilt or moisture stress prior to harvest increases sugar concentration but reduces overall yield. Wilted beets tend to be more difficult to store and process. Normal growth will resume when adequate moisture becomes available for crop use.

It is also important to plan the last irrigation carefully; both wet and dry conditions will hamper harvesting.

Sugar beets are most sensitive to moisture shortages in the early growing stages but their peak moisture use comes late in the season when they have complete ground cover (See Figure 1). Sugar beets obtain approximately 70 per cent of their water needs from the top 60 cm (2 ft) of the root zone. Where poor soil conditions such as hard pans or fluctuating water tables exist, root development becomes restricted, increasing the amount of water withdrawn from the top portion of the root zone.

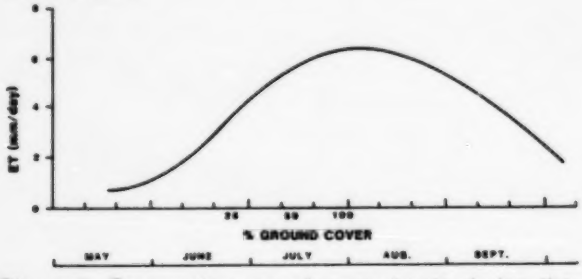


*Figure 1. Crop water use of sugar beets during the growing season.*

There exists a positive relationship between water use by the crop and dry matter and sugar content (See Figure 2). Sugar concentration of roots increases with the age of the plant until harvest. Over-irrigation reduces sugar content because of a depression in sugar concentration.

Although 49 t/bu (22 tons/ac) is considered respectable, yields of 78 t/ha (36 tons/ac) of sugar beets have been attained in research plots.

## Comments

Stand establishment is extremely important for obtaining high yields. Maintaining adequate moisture in the top 30 cm (1 ft) of the root zone during the seedling stage will help to achieve this high level of production. If moisture conditions are poor for seed germination, several light applications of water (25 mm) close together

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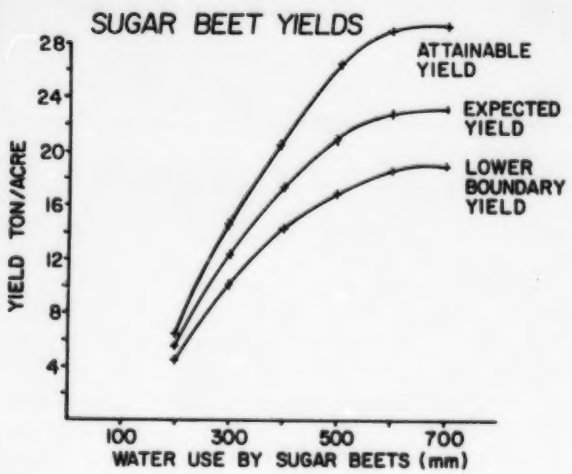



*Figure 2.*

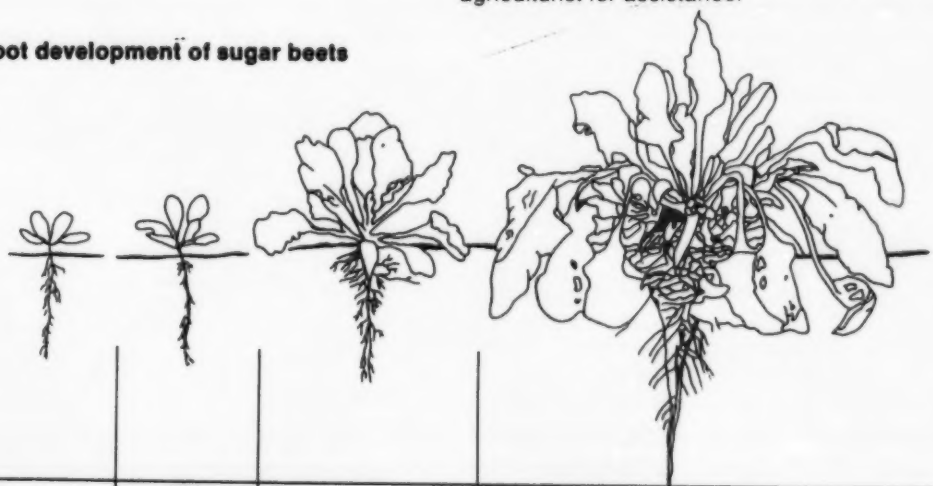
will aid in uniform germination. Applying large amounts of water may result in cold soil temperatures or soil crusting which delays germination.

Fall irrigation is recommended when levels of available soil moisture fall below the 50 per cent allowable depletion level after harvest. Soil moisture conditions need to be determined for the root zone before water is applied to ensure that over-irrigation does not occur and that sufficient room is available in the root zone for any precipitation that may occur over winter. The amount of water applied should refill the root zone to the 50 per cent allowable depletion level.

## Irrigation Management Information

For further information regarding irrigation management of sugar beets, contact your nearest Irrigation Branch office. These offices are located at: Lethbridge, 381-5136; Vauxhall, 654-2161; Airdrie, 948-8511; Taber, 223-7908; Strathmore, 934-3356; Brooks, 362-1212; Bow Island, 545-2231; Medicine Hat, 529-3616. North of Calgary, contact the Airdrie office or your local district agriculturist for assistance.

**Growth and root development of sugar beets**



| GROWTH PERIODS | EMERGENCE | 50% GROUND COVER | 100% GROUND COVER | HARVEST |
|---|---|---|---|---|
| POST EMERGENCE DATES | 10–15 DAYS | 50–60 DAYS | 80–85 DAYS | 130–135 DAYS |
| CROP * ROOTING DEPTH | 2.0cm/DAY | | MINIMAL ROOT EXTENSION | |
| MOISTURE SENSITIVE PERIOD** | | | | |
| AVERAGE E.T. | 1.5–4.0mm /DAY | 4.0–5.0mm /DAY | 5.0–6.0mm/DAY | < 6.0mm/DAY |

* Maximum rooting depth will occur approximately the time 100% ground cover occurs.

** For optimum production, the first irrigation wil be required before the crop enters into its water sensitive period.

The above depths, times and amounts are only average values for this particular crop. These values will change depending on the area where this crop is grown.

## Soil

Soils can vary greatly in texture from being very fine (clay) to very coarse (sand) within a crop root zone. Because soil texture can change quite quickly, so can the amount of water that the soil is able to hold.

| Texture | Available Moisture |
|---|---|
| Loamy sand | 8-12 mm/0.1m (0.9-1.4 in./ft) |
| Sand loam | 10-15 mm/0.1m (1.2-1.8 in./ft) |
| Loam | 14-18 mm/0.1m (1.7-2.1 in./ft) |
| Sand clay loam, clay loam, clay | 15-20 mm/0.1m (1.8-2.4 in./ft) |
| Silty clay loam, silt loam | 16-22 mm/0.1m (1.9-2.6 in./ft) |

It is important to know and to be able to calculate the amount of moisture present in the soil root zone in order to understand the amount of moisture available for crop use. The allowable depletion level is the amount of soil moisture that can safely be removed from the root zone by a crop before an irrigation is required. For sugar beets, the allowable depletion level has been determined to be 50 per cent. The simplest way to determine soil moisture content is by the "feel" method. By feeling, squeezing and observing a handful of soil, one can determine the amount of moisture present in the soil. The following chart outlines the various characteristics of soil based on different contents of water.

| | | Feel or Appearance of Soils | | |
|---|---|---|---|---|
| | PERCENT OF AVAILABLE MOISTURE REMAINING | MODERATELY COARSE TEXTURE | MEDIUM TEXTURE | MODERATELY FINE TEXTURE |
| DO NOT IRRIGATE | At field capacity 100 | Upon squeezing no free water appears on soil but wet outline of ball is on left hand. | Same as sandy loam. | Same as sandy loam. |
| | 75 to field capacity | Forms a weak ball, breaks easily, will not slide. | Forms a ball and is very pliable; slicks readily if relatively high in clay. | Easily ribbons out between fingers, has a slick feeling. |
| IRRIGATE SPEC. CROPS | 50 to 75 | Tends to ball under pressure but seldom will hold together | Forms a ball; somewhat plastic; will sometimes slick slightly with pressure. | Forms a ball, will ribbon out between thumb and forefinger |
| IRRIGATE | 25 to 50 | Still appears to be dry, wil not form ball with pressure.* | Somewhat crumbly but will hold together from pressure. | Somewhat pliable, will ball under pressure. |
| | 0 to 25 | Dry, loose, single-grained, flows through fingers. | Powdery, dry, sometimes slightly crusted but easily breaks down into powdery condition. | Hard, baked, cracked; sometimes has loose crumbs on surface. |

* Ball is formed by squeezing a handful of soil firmly